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.	not available for any reference period
..	not available for a specific reference period
...	not applicable
0	true zero or a value rounded to zero
0^s	value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
^{p}	preliminary
^{r}	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
^{E}	use with caution
F	too unreliable to be published
*	significantly different from reference category ($p < 0.05$)

Self-monitoring of blood glucose in type 2 diabetes: Results of the 2011 Survey on Living with Chronic Diseases in Canada

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Abstract

Background
For insulin-treated patients with type 2 diabetes mellitus (T2DM), self-monitoring of blood glucose (SMBG) may be vital in adjusting insulin dosages. For patients who do not use insulin, evidence supporting the use of SMBG is inconclusive.

Methods
The prevalence, frequency and correlates of SMBG are examined. Data pertain to 2,682 individuals aged 20 or older with T2DM who responded to the 2011 Survey on Living with Chronic Diseases in Canada. Multivariate prevalence rate ratios for associations between respondents' characteristics and their use of SMBG were derived using binomial regression models.

Results
A large majority of the study population (87.8%) reported SMBG. No difference in the prevalence of SMBG was observed between oral medication users compared with insulin users; however, the frequency of SMBG was lower for those taking oral medication only. Significant determinants of SMBG were a health professional's recommendation, having insurance coverage, and receiving an A1C test from a health professional.

Interpretation
The use of SMBG by adults with T2DM is common, and does not differ between those taking oral medication only and those treated with insulin.

Keywords
Clinical protocols, consensus, health care surveys, patient compliance, practice guidelines, self care

Authors
Calypse B. Agborsangaya and Jeffrey A. Johnson are with the University of Alberta, Edmonton, Alberta, T6G 2E1. Cynthia Robitaille, Sulan Dai and Catherine Pelletier are with the Public Health Agency of Canada. Peggy Dunbar, is with the Diabetes Care Program of Nova Scotia. Marie-France Langlois is with the Université de Sherbrooke. Lawrence A. Leiter is with the University of Toronto.

Self-monitoring of blood glucose (SMBG) is a useful component of diabetes management. SMBG entails collecting information on blood glucose levels at different times of the day. SMBG is, therefore, important for patients with type 2 diabetes mellitus (T2DM) using insulin, because it enables them to detect hypoglycemia and self-administer doses of insulin for glycemic control.[1-3]

However, for T2DM patients who do not use insulin, evidence supporting the clinical relevance and cost-effectiveness of SMBG is equivocal.[4-9] Hypoglycemia in these patients is rare,[10] and the extent to which they can adjust anti-hyperglycemic agents in response to SMBG readings is generally limited.[11] Nonetheless, some Clinical Practice Guidelines (CPGs) recommend routine SMBG in T2DM patients who do not use insulin.[11] CPGs in Canada recommend that SMBG be individualized for each patient,[11] but the Canadian Agency for Drugs and Technologies in Health does not recommend the routine use of blood glucose test strips for this patient population.[1]

Studies evaluating the prevalence of SMBG among T2DM patients have had different outcome measures and have focused on specific subgroups.[4,12-16] Only a few reports have been based on nationally representative data.[17,18] Because self-monitoring may vary with population characteristics,[19] a broader examination of the extent of SMBG is needed to inform discussions about its utility, and perhaps, to update CPGs. As well, associations between the frequency of SMBG and factors such as self-management support and insurance coverage should be considered.

This study examines the prevalence, frequency and correlates of SMBG, based on a nationally representative sample of patients with T2DM.

Methods

Study population

The data are from the 2011 Survey on Living with Chronic Diseases in Canada - Diabetes Component (SLCDC-DM).[20] Respondents aged 20 or older to the 2010 Canadian Community Health Survey (CCHS) who reported that a health care professional had diagnosed them as having diabetes were eligible for participation in the 2011 SLCDC-DM. The CCHS excludes members of the Canadian Forces and residents of First Nations

Reserves, Crown lands, institutions, and the three territories. Of the 3,590 CCHS respondents contacted, 2,933 agreed to participate in the SLCDC, for a response rate of 81.7%. Additional information about the 2011 SLCDC is available online.[20]

This analysis excluded respondents who reported having type 1 diabetes (n = 211), those with another type of diabetes (n = 19), those who did not know the type (n = 14), and women who did not state whether they had been diagnosed with diabetes other than during pregnancy (n = 7). This left 2,682 respondents.

Descriptive variables

The socio-demographic characteristics of the population examined in this analysis are sex, age, racial background, education and household income. Except for age and sex, socio-demographic information came from linkage of the 2010 CCHS and the 2011 SLCDC.

Measures

To determine the prevalence and frequency of SMBG, respondents were asked, "Do you or a family member or friend check your blood sugar?" Those who answered "yes" were asked, "How often do you....check your blood sugar level?" Patients reported frequency in different units (per day, week, month or year); for this analysis, all values were converted to "per week" (for example, per day values were multiplied by 7).

For the health care correlates of SMBG, patients were asked if a doctor or other health professional had ever recommended monitoring their blood sugar level and/or had given them an A1C test (a simple lab test that reflects average blood glucose level over the last three months). Patients who replied affirmatively to the latter were asked, "The last time your A1C was measured by a health professional, . . . your blood sugar was: normal, borderline, high, low, did not say?" For this analysis, borderline and normal were combined. Respondents were also asked: the type of medication they used to control their glucose level; if they had insurance coverage for glucose monitoring; and if they had visited an emergency room in the past 12 months because of hypoglycemia.

Statistical analysis

The weighted prevalence and mean frequency of SMBG were determined by socio-demographic and health care characteristics. Z statistics were used to identify differences in the prevalence and frequency of SMBG across descriptors, receipt of health professional support, clinical monitoring, insurance coverage, hypoglycemia-related emergency room visits, and medication use. Multivariate prevalence rate ratios for the associations between these clinically relevant characteristics and SMBG were tested using binomial regression models.

Point estimates were weighted using the survey sample weights to reflect the Canadian population aged 20 or older living in private dwellings. To account for the complex survey design, 95% confidence intervals were calculated using exact standard errors generated through bootstrap re-sampling methods.[21] Missing data were excluded from the analyses. Data were analyzed using SAS Enterprise Guide 4.1 (Cary, North Carolina).

Table 1
Selected socio-demographic characteristics, household population aged 20 or older with type 2 diabetes mellitus, Canada excluding territories, 2011

Characteristics	Sample size	Percentage distribution	95% confidence interval	
			from	to
Sex				
Women	1,338	41.9	39.1	44.8
Men	1,344	58.1	55.2	60.9
Age group (years)				
20 to 44	118	6.6	4.9	8.4
45 to 64	1,003	45.7	42.5	49.0
65 or older	1,561	47.6	44.6	50.7
Mean (standard error) = 63.4 (0.4)				
Racial background				
White	2,428	81.0	77.8	84.2
Other	243	19.0	14.8	23.3
Education				
Less than secondary school graduation	613	14.6	12.8	16.5
Secondary school graduation	371	12.3	10.4	14.2
Some postsecondary education	164	6.5	4.8	8.2
Postsecondary graduation	1,471	66.7	63.6	69.6
Household income				
Less than $15,000	256	7.1	5.6	8.6
$15,000 to $29,999	648	19.5	17.0	21.9
$30,000 to $49,999	637	25.0	22.1	27.9
$50,000 to $79,999	501	25.5	22.3	28.7
$80,000 or more	368	23.0	19.8	26.1
Time since diagnosis (years)				
Less than 2	396	15.4	12.9	17.8
3 to 5	549	21.9	19.1	24.6
6 to 9	460	17.9	15.6	20.2
10 or more	1,258	44.9	41.6	48.1

Source: 2011 Survey on Living with Chronic Diseases in Canada – Diabetes Component.

Results

Prevalence of self-monitoring of blood glucose

The majority of the 2,682 respondents aged 20 or older with T2DM were men (58%), White (81%), and had completed postsecondary education (67%). Close to half (48%) were aged 65 or older (Table 1).

Most of these T2DM patients (88%) reported having used SMBG during the past 12 months. No significant differences in the prevalence of SMBG were observed by sex, age, education, household income, racial background or time since diagnosis (Table 2). When these characteristics were taken into account, health care factors associated with SMBG were health professional recommendations, having insurance coverage for the procedure, and having had an A1C test from a health professional. As expected, patients not using any medication were less likely to report SMBG than were those using insulin only. However, no significant difference was apparent between those using insulin only and those taking insulin plus oral medication, or an oral agent only.

Frequency of self-monitoring of blood glucose

Patients who self-monitored their blood glucose did so an average of more than 10 times a week, a figure that did not differ significantly by sex, age, education or racial background (Table 3). However, frequency tended to decrease at higher household income levels. For example, those whose household income was less than $15,000 reported that they self-monitored their blood glucose around 12 times a week, compared with about 8 times a week for those whose household income was $80,000 or more.

The average frequency of SMBG was higher among patients who reported having had an A1C test by a health professional than among those who did not (10.6 versus 8.5 times a week). As well, the average frequency was significantly higher among respondents reporting high A1C levels, compared with those reporting normal levels

Table 2
Prevalence of self-monitoring of blood glucose (SMBG), by socio-demographic and health care characteristics, household population aged 20 or older with type 2 diabetes mellitus, Canada excluding territories, 2011

Characteristics	Sample size	Weighted percent	95% confidence interval from	95% confidence interval to	Prevalence rate ratio	95% confidence interval from	95% confidence interval to
Socio-demographic							
Sex							
Men†	1,199	86.1	82.8	89.5	1.0	...	...
Women	1,212	90.1	87.3	92.9	1.0	0.9	1.0
Age group (years)							
20 to 44†	107	89.2	82.0	96.3	1.0	...	...
45 to 64	910	87.0	83.0	91.0	1.0	0.9	1.1
65 or older	1,394	88.4	85.6	91.2	1.0	0.9	1.1
Education							
Less than secondary school graduation†	553	89.1	84.3	93.9	1.0	...	...
Secondary school graduation	325	86.3	80.3	92.3	1.0	0.9	1.1
Some postsecondary education	153	89.4	81.8	97.0	1.0	0.9	1.2
Postsecondary graduation	1,325	87.3	84.1	90.5	1.0	0.9	1.1
Household income							
Less than $15,000†	228	90.3	85.3	95.2	1.0	...	...
$15,000 to $29,999	573	86.6	81.6	91.5	1.0	0.9	1.1
$30,000 to $49,999	572	86.1	81.0	91.2	1.0	0.9	1.1
$50,000 to $79,999	457	88.1	82.7	93.7	1.0	0.9	1.1
$80,000 or more	336	88.4	83.1	93.7	1.0	0.9	1.1
Racial background							
White†	2,187	88.5	86.2	90.8	1.0	...	...
Other	215	85.3	77.8	92.7	0.9	0.9	1.0
Time since diagnosis (years)							
Less than 6†	820	83.6	79.2	88.1	1.0	...	...
6 or more	1,575	90.3	87.8	92.9	1.1	1.0	1.1
Health care							
Health professional recommendation for SMBG							
No†	116	42.5	30.8	54.2	1.0	...	...
Yes	2,293	93.0	91.3	94.8	1.7*	1.2	2.3
Insurance coverage for SMBG							
No†	678	78.5	73.2	83.8	1.0	...	...
Yes	1,697	92.9	90.6	95.3	1.1*	1.1	1.2
Clinical monitoring (A1C measured by health professional)							
No†	439	78.5	72.0	85.0	1.0	...	...
Yes	1,847	90.4	88.2	92.7	1.1*	1.0	1.2
Clinical monitoring (A1C level)							
Normal†	1,248	89.6	86.9	92.2	1.0	...	...
High	409	92.6	87.5	97.7	1.0	1.0	1.1
Other	168	91.4	85.1	97.8	1.0	1.0	1.1
Hypoglycemia-related emergency room visit							
No†	2,357	87.6	85.3	90.0	1.0	...	...
Yes	51	93.8	83.3	100.0	1.0	0.9	1.1
Medication use							
Insulin only†	169	94.5	85.2	100.0	1.0	...	...
Insulin and pills	360	98.5	96.1	100.0	1.0	1.0	1.1
Pills only	1,558	89.3	86.5	92.0	1.0	0.9	1.0
None	306	67.5	59.5	75.5	0.9*	0.8	0.9

† reference category
* significantly different from reference category ($p < 0.05$)
... not applicable
Note: Prevalence rate ratio adjusts for age, sex, education, household income and time since diagnosis.
Source: 2011 Survey on Living with Chronic Diseases in Canada – Diabetes Component.

Table 3
Frequency of self-monitoring of blood glucose (SMBG), by socio-demographic and health care characteristics, household population aged 20 or older with type 2 diabetes mellitus, Canada excluding territories, 2011

Characteristics	Mean times per week	95% confidence interval	
		from	to
Socio-demographic			
Sex			
Men†	10.3	9.2	11.2
Women	11.1	10.3	12.0
Age group (years)			
20 to 44†	9.1	6.2	11.9
45 to 64	11.0	9.7	12.3
65 or older	10.5	9.7	11.3
Education			
Less than secondary school graduation†	11.5	10.1	12.9
Secondary school graduation	10.7	9.3	12.3
Some postsecondary education	10.8	8.7	12.9
Postsecondary graduation	10.4	9.4	11.4
Household income			
Less than $15,000	12.3*	10.5	14.2
$15,000 to $29,999	11.9*	10.4	13.4
$30,000 to $49,999	10.5*	9.2	11.8
$50,000 to $79,999	10.6*	9.2	12.0
$80,000 or more†	8.3	7.2	9.4
Racial background			
White†	10.7	9.9	11.4
Other	9.9	8.2	11.6
Time since diagnosis (years)			
Less than 6†	8.7	7.7	9.7
6 or more	11.3*	10.6	12.1
Health care			
Health professional recommendation for SMBG			
No†	10.6	6.6	14.6
Yes	10.4	9.8	11.0
Insurance coverage for SMBG			
No†	9.4	8.2	10.7
Yes	10.7	10.0	11.4
Clinical monitoring (A1C measured by health professional)			
No†	8.5	7.4	9.7
Yes	10.6*	9.9	11.3
Clinical monitoring (A1C level)			
Normal†	10.1	9.3	10.9
High	12.6*	11.3	14.0
Other	9.4	6.8	12.1
Hypoglycemia-related emergency room visit			
No†	10.2	9.6	10.8
Yes	18.4*	15.2	21.6
Medication use			
Insulin only†	18.7	16.7	20.7
Insulin and pills	16.7	14.9	18.6
Pills only	8.4*	7.8	9.0
None	6.3*	5.4	7.2

† reference category
* significantly different from reference category ($p < 0.05$)
Source: 2011 Survey on Living with Chronic Diseases in Canada – Diabetes Component.

(12.6 versus 10.1). SMBG was significantly more frequent among patients who had a hypoglycemia-related emergency room visit, compared with those who did not (18.4 versus 10.2 times a week). SMBG frequency was also related to medication use: 18.7 times a week for patients taking insulin only, 8.4 times for those taking oral medication only, and 6.3 times for those not taking insulin or oral medications.

Discussion

According to the results of this study, SMBG is common and frequent among adults with T2DM. The estimated prevalence was almost 88%, close to the 91% cited in a previous Canadian report.[18] Factors significantly associated with SMBG included a health professional recommendation, having had an A1C test by a health professional, and health insurance coverage for glucose monitoring. The prevalence of SMBG did not differ for patients using only insulin, compared with those using insulin and oral medication, or oral medication only.

In fact, the prevalence of SMBG was 89% in patients using only oral medication. Hypoglycemia is rare in such patients,[10] and the extent to which doses of oral anti-hyperglycemic agents can be adjusted in response to SMBG is limited.[2] A systematic review conducted by the Canadian Agency for Drugs and Technology in Health[3] reported that SMBG in patients who do not use insulin results in only marginal improvement in glycated hemoglobin (A1C) levels. Moreover, SMBG among these patients may entail substantial financial outlays—by the patients themselves and by payers.[12,22,23]

Having insurance coverage for all or part of the cost of glucose monitoring was associated with a higher prevalence of SMBG. Although the causal direction of the associations cannot be ascertained, insurance and other reimbursement policies may encourage SMBG in patients with T2DM.[24,25] In Canada, reimbursement for SMBG varies widely by province, ranging from full coverage under a pharmaceutical benefits program

with co-payments and deductibles to no coverage.[26]

The advice of health professionals is important for the management of T2DM.[27] This analysis shows that patients were more likely to report SMBG if a health professional had recommended it, or if they had received an A1C test from a health professional.

In this study, the frequency of SMBG among patients using insulin is consistent with national and international CPGs,[2,11,28] including those of the Canadian Agency for Drugs and Technology in Health.[1,29] Patients on insulin-only treatment used SMBG an average 19 times per week, which is close to the Canadian CPGs' recommendation of a minimum of three times a day.[11]

However, the frequency of SMBG by medication use in this analysis was about twice the values in previous Canadian reports based on claims data[12,30] and in some international studies.[14,31] Claims data are usually derived from fee-for-service administrative records, which potentially exclude individuals whose physicians do not use that billing method. In fact, the findings of the present analysis are similar to patterns reported in a study using a combined Canadian aggregated and claims level dataset.[22]

The higher mean frequency of SMBG among patients with lower household incomes is noteworthy. For people without comprehensive coverage for SMBG, out-of-pocket expenditures may result in income-related disparities in SMBG frequency.[32] In Canada, however, the extent of coverage for glucose monitoring differs by province. Whether the differences by household income in the frequency of SMBG are due to differences in provincial coverage policies, age, literacy level, or disease severity remains to be tested.

Limitations

This study has several limitations. The cross-sectional design precludes determination of causality. The data were self-reported and so may be subject to social desirability bias, in that patients may report diabetes self-care in a way that they think is socially acceptable. No objective measures were available against which to assess the accuracy of patient reports or the recommendations and support patients received from health professionals. Sampling bias may limit the generalizability of the findings; for example, residents of the three territories and of First Nations reserves were not included in the study. Finally, other factors that may confound the associations, such as access to care, patients' language proficiency and health literacy, and health professionals' practice style, were not captured in this analysis.

Conclusion

This study presents comprehensive, nationally representative data on the prevalence, correlates and frequency of SMBG among adults with T2DM. SMBG is common and is associated with receipt of recommendation for SMBG and an A1C test from a health professional, as well as having insurance coverage for glucose monitoring. The prevalence of SMBG did not differ among patients using only insulin and those taking medication only. These findings have implications for the development of clinical recommendations for SMBG in persons with T2DM. ■

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What is already known on this subject?

- Information about the extent of self-monitoring of blood glucose (SMBG) in patients with type 2 diabetes mellitus (T2DM) is largely based on claims data, or pertains to specific subgroups.
- No consensus exists on the optimal frequency of SMBG in T2DM patients.

What does this study add?

- This analysis presents an up-to-date assessment of the extent of SMBG for the management of T2DM and factors associated with SMBG among Canadian adults.
- Receipt of a health professional recommendation, receipt of an A1C test from a health professional, and having health insurance coverage for glucose monitoring were significantly associated with SMBG.
- The prevalence of SMBG did not differ for patients using *insulin only*, compared with those using *insulin and oral medication* or *oral medication only*.
- These findings may have implications for the development of clinical practice guidelines.

References

1. Canadian Agency for Drugs and Technologies in Health. *Optimal Therapy Recommendations for the Prescribing and Use of Blood Glucose Test Strips*. Ottawa: Canadian Agency for Drugs and Technologies in Health, 2010.
2. Bergenstal RM, Gavin JR3rd. The role of self-monitoring of blood glucose in the care of people with diabetes: report of a global consensus conference. *The American Journal of Medicine* 2005; 118(Suppl 9A): 1S-6S.
3. Canadian Agency for Drugs and Technologies in Health. *Systematic Review of Use of Blood Glucose Test Strips for the Management of Diabetes Mellitus*. Ottawa: Canadian Agency for Drugs and Technologies in Health, 2010.
4. Martin S, Schneider B, Heinemann L, et al. Self-monitoring of blood glucose in type 2 diabetes and long-term outcome: an epidemiological cohort study. *Diabetologia* 2006; 49(2): 271-8.
5. Guerci B, Drouin P, Grange V, et al. Self-monitoring of blood glucose significantly improves metabolic control in patients with type 2 diabetes mellitus: the Auto-Surveillance Intervention Active (ASIA) study. *Diabetes and Metabolism* 2003; 29(6): 587-94.
6. Davidson MB, Castellanos M, Kain D, Duran P. The effect of self monitoring of blood glucose concentrations on glycated hemoglobin levels in diabetic patients not taking insulin: a blinded, randomized trial. *The American Journal of Medicine* 2005; 118(4): 422-5.
7. Welschen LM, Bloemendal E, Nijpels G, et al. Self-monitoring of blood glucose in patients with type 2 diabetes mellitus who are not using insulin. *Cochrane Database of Systematic Reviews* 2005(2): CD005060.
8. Malanda UL, Welschen LM, Riphagen II, et al. Self-monitoring of blood glucose in patients with type 2 diabetes mellitus who are not using insulin. *Cochrane Database of Systematic Reviews* 2012; 1: CD005060.
9. St John A, Davis WA, Price CP, Davis TM. The value of self-monitoring of blood glucose: a review of recent evidence. *Journal of Diabetes and its Complications* 2010; 24(2): 129-41.
10. Bodmer M, Meier C, Krahenbuhl S, et al. Metformin, sulfonylureas, or other antidiabetes drugs and the risk of lactic acidosis or hypoglycemia: a nested case-control analysis. *Diabetes Care* 2008; 31(11): 2086-91.
11. Canadian Diabetes Association Clinical Practice Guidelines Expert Committee. *Canadian Diabetes Association 2008 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada*. Toronto: Canadian Diabetes Association, 2008.
12. Johnson JA, Pohar SL, Secnik K, et al. Utilization of diabetes medication and cost of testing supplies in Saskatchewan, 2001. *BMC Health Services Research* 2006; 6: 159.
13. Gomes T, Juurlink DN, Shah BR, et al. Blood glucose test strips: options to reduce usage. *Canadian Medical Association Journal* 2010; 182(1): 35-8.
14. Self-monitoring of blood glucose in type 2 diabetes: an inter-country comparison. *Diabetes Research and Clinical Practice* 2008; 82(3): e15-8.
15. Karter AJ, Parker MM, Moffet HH, et al. Longitudinal study of new and prevalent use of self-monitoring of blood glucose. *Diabetes Care* 2006; 29(8): 1757-63.
16. Morgan CL, Griffin A, Chamberlain GH, et al. A longitudinal study into the new and long-term use of self-monitoring blood glucose strips in the UK. *Diabetes Therapy* 2010; 1(1): 1-9.
17. Nwasuruba C, Khan M, Egede LE. Racial/ethnic differences in multiple self-care behaviors in adults with diabetes. *Journal of General Internal Medicine* 2007; 22(1): 115-20.
18. Canadian Institute of Health Information. *Diabetes Care Gaps and Disparities in Canada*. Ottawa: Canadian Institute of Health Information, 2009. Available at: http://secure.cihi.ca/free_products/Diabetes_care_gaps_disparities_aib_e.pdf. Accessed May 11, 2012.
19. Hjelm K, Nyberg P, Apelqvist J. Self-monitoring of blood glucose; frequency, determinants and self-adjustment of treatment in an adult Swedish diabetic population: utilisation and determinants of SMBG. *Practical Diabetes International* 2011; 18(5): 157-63.
20. Statistics Canada. *Survey on Living with Chronic Diseases in Canada (SLCDC)*. Ottawa: Statistics Canada, 2011. Available at: http://www23.statcan.gc.ca:81/imdb/p2SV.pl?Function=getSurvey&SDDS=5160&lang=en&db=imdb&adm=8&dis=2.
21. Rust KF, Rao JN. Variance estimation for complex surveys using replication techniques. *Statistical Methods in Medical Research* 1996; 5(3): 283-310.
22. Cameron C, Virani A, Dean H, et al. Utilization and expenditure on blood glucose test strips in Canada. *Canadian Journal of Diabetes* 2010; 34(1): 34-40.
23. Canadian Diabetes Association. *The Prevalence and Costs of Diabetes*. Toronto: Canadian Diabetes Association, 2009. Available at: www.diabetes.ca/files/PrevalenceandCost.pdf.
24. Johnson JA, Majumdar SR, Bowker SL, et al. Self-monitoring in type 2 diabetes: a randomized trial of reimbursement policy. *Diabetic Medicine: A Journal of the British Diabetic Association* 2006; 23(11): 1247-51.
25. Nyomba BL, Berard L, Murphy LJ. The cost of self-monitoring of blood glucose is an important factor limiting glycemic control in diabetic patients. *Diabetes Care* 2002; 25(7): 1244-5.
26. Mitchell CG, Simpson SH, Johnson JA. Observed costs of diabetes testing supplies in Saskatchewan. *Canadian Journal of Clinical Pharmacology* 2002; 9: 3.
27. Rosenbek Minet LK, Lonvig EM, Henriksen JE, Wagner L. The experience of living with diabetes following a self-management program based on motivational interviewing. *Qualitative Health Research* 2011; 21(8): 1115-26.
28. American Diabetes Association. Standards of medical care in diabetes - 2008. *Diabetes Care* 2011; 34: S1-S2.
29. Canadian Diabetes Association. 2008 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada. *Canadian Journal of Diabetes* 2008; 32(Suppl 1): S1-S201.
30. Sanyal C, Graham SD, Cooke C, et al. The relationship between type of drug therapy and blood glucose self-monitoring test strips claimed by beneficiaries of the Seniors' Pharmacare Program in Nova Scotia, Canada. *BMC Health Services Research* 2008; 8: 111.
31. Belsey JD, Pittard JB, Rao S, et al. Self blood glucose monitoring in type 2 diabetes. A financial impact analysis based on UK primary care. *International Journal of Clinical Practice* 2009; 63(3): 439-48.
32. Karter AJ, Ferrara A, Darbinian JA, et al. Self-monitoring of blood glucose: language and financial barriers in a managed care population with diabetes. *Diabetes Care* 2000; 23(4): 477-83.